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### Influence of coloured light on broiler bird performance

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#### Abstract

Poultry sector is one of the fastest growing sectors in India. Poultry is affected by lot of environmental factors like temperature, humidity, ventilation etc and light is one of the main factors affecting poultry. Light may be the most critical of all environmental factors to birds. Light affects broilers growth, Carcass yield and characteristics, behaviour and also affects the bird at blood level. Different sources of coloured lights affect the melatonin release from the hypothalamus thereby, affecting bird's performance. Light allows the bird to establish rhythmicity and synchronize many essential functions, including many physiological and behavioral processes in broiler birds. Thus, this review article will highlight the influence of various coloured light sources on broiler bird's performance.

**Keywords:** Broiler, birds, coloured, light, performance

#### Introduction

Light plays an important role in bird's life. Avian species as well as mammalian species respond to light energy in a variety of ways; they sense the light through their eyes (retinal photoreceptors) and through photosensitive cells in the brain (extra-retinal photoreceptors). It has been observed that growth and behavior are linked to retinal photoreception whereas the reproduction has been linked to extra-retinal photoreceptors (Rozenboim *et al.*, 1999)<sup>[1]</sup>. Light may be the most critical of all environmental factors to birds. It is integral to sight, including both visual acuity and color discrimination (Manser, 1996)<sup>[2]</sup>. Light allows the bird to establish rhythmicity and synchronize many essential functions, including many physiological and behavioral processes in broiler birds. Light intensity, color, and the photoperiodic regime can affect the physical activity of broiler chickens (Lewis and Morris, 1998)<sup>[3]</sup> and there by affect the production performance of broiler birds. The colour of light has many different effects on behavior, growth and reproduction. The colour of light has many different effects on behavior and growth performance. During the early period short wavelength appear to stimulate growth and as the bird approaches the time of sexual maturity long wavelength increases the growth. Blue light has a calming effect on birds; however red light has been used to reduce cannibalism and feather picking. Generally, four kinds of lamps are used by poultry producers-incandescent, fluorescent, metal halide and high pressure sodium. All four types are used in poultry facilities for laying hens, breeder flocks and broilers. Thus, the present article will aims towards the effect of coloured light on performance of broiler birds in terms of growth, carcass characteristics, biochemical evaluation, behavioural response and ultimately economics of broiler production.

#### Effect of coloured light on growth performance of broilers

Colour of light affects the growth of broiler birds by altering the melatonin release from the hypothalamus. Green and blue monochromatic light combination affects the broiler growth (Rozenboim *et al.*, 2004)<sup>[4]</sup> and switching light at 10 days of age from green to blue caused an increased in body weight and switching light at 20 days of age from blue to green caused an improved growth as compared with white light. Broilers growth and productive performance were increased under green light during the early period (0 to 26 d of age) and blue light during the later period (27 to 49 d of age). Furthermore, both blue and green lights were more effective to stimulate testosterone secretion and Myofiber growth that led to increase body growth (Cao *et al.*, 2008)<sup>[5]</sup>. Body weight, body weight gain and feed intake was higher in

yellow light at 5<sup>th</sup> week of life whereas birds reared under incandescent light attained the lowest numerical body weight (Kim *et al.*, 2013)<sup>[6]</sup>. Application of green or yellow lights on broilers did not significantly affect the mortality rate, average live weight and average feed consumption compared with white light. However, application of green light on the broilers has led to a significant reduction (4.4%,  $p \leq 0.05$ ) in the feed conversion rate for the whole period of fattening compared with white light (Assaf *et al.*, 2015)<sup>[7]</sup>. However, the use of green Light emitting diode (LED) light promoted higher Energy Efficiency Index in males in weeks 5, 6, and 7, and in females in week 5 (Guevara *et al.*, 2015)<sup>[8]</sup>. Body weights were higher in chickens reared under Pure Blue and Green Blue on day 7 and Sky Blue on day 21 than the other groups (Seo *et al.*, 2016)<sup>[9]</sup>. The Body Weight, Body Weight gain and live weight of birds reared under cool poultry specific filtered LED were different in comparison to birds reared under incandescent light (Olanrewaju and Maslin, 2016)<sup>[10]</sup>. Broilers reared under mini-fluorescent light bulb and incandescent light bulbs were having significantly higher body weight at 19 and 42 days of age than birds reared under fluorescent lamps. Whereas, at 49 days of age birds under mini-fluorescent light bulb were having significantly ( $p \leq 0.05$ ) higher body weight than birds in all other treatment groups. There were no differences in mortality rate and food efficiency between the three light sources and all were within the normal range. The better growth under fluorescent light bulb may be the result of either the specific spectrum of the fluorescent lamp or its lower frequency of emission of light (Rozenboim *et al.*, 1999b)<sup>[11]</sup>.

#### **Effect of coloured light on Carcass characteristics of broilers**

Carcass characteristics and Carcass quality parameters are affected by the coloured light and the number of satellite cells per gram of breast muscle and total number of satellite cells was substantially higher in the groups reared under green and blue light, compared to the red and white light groups. Growth hormone receptor gene expression was also higher in the former groups and higher muscle weight found in the green and blue light groups was due to increased satellite cell proliferation during the first days of age (Halevy *et al.*, 1998)<sup>[12]</sup>. Muscles of breast and thigh in Green light and Blue light had higher pH, water-holding capacity and protein content, whereas cooking loss, lightness value, shear value, and fat content were lower compared with Red light (Ke *et al.*, 2011)<sup>[13]</sup>. The breast muscle weight and breast muscle percentages in birds incubated under green light were significantly elevated by 50.39 g (0.76%) and 54.07 g (1.20%) than those in the dark condition or blue group at 42 d of market age respectively and it is due to the fact that green light stimuli during embryogenesis enhanced the post hatch Body weight of male broilers, increased breast muscle growth and improved the feed conversion ratio but it did not cause any noticeable changes in breast chemical composition or overall meat quality characteristics (Zhang *et al.*, 2011)<sup>[14]</sup>. Eviscerated carcass weight and breast, thigh and crus muscle weight under green-blue were greater by 0.40 to 56.23% than for those with other light groups except white-blue (eviscerated carcass) and blue-green (breast muscle) (Cao *et al.*, 2012)<sup>[15]</sup>. Meat pH increased in chicks exposed to the blue and green-blue light treatments and decreased in those exposed to the red and red-yellow light treatments (Hassan and Sultana, 2013)<sup>[16]</sup>.

#### **Effect of coloured light on Biochemical evaluation of broilers**

Broiler birds are affected by the colour of light and lighting program could affect the blood composition and hematological parameters of broiler birds. Broiler birds of 21 days of age reared under yellow and green light treatment had higher level of IgG than those of birds reared under the white light treatments, whereas birds reared under the yellow-green, green-blue and blue light treatments had intermediate level of IgG (Hassan *et al.*, 2014)<sup>[17]</sup>. Birds in yellow light house showed a significant increase in total serum protein and the birds in blue light house showed an insignificant reduction in serum triglyceride, glucose and BUN concentrations (Firouzi *et al.*, 2014)<sup>[18]</sup>. Birds under blue light group showed a 44.0% reduction in the level of serum interleukin-1 $\beta$  as compared with that in the red light group at 49 days of age (Xie *et al.*, 2008)<sup>[19]</sup>.

#### **Effect of coloured light on Behavioural response of broilers**

Color and intensity of light affect the behavior of broiler chickens. Prayitno *et al.*, 1997<sup>[20]</sup> reported that walking, standing, drinking, aggression and wing stretching increased with increased intensity in red light but not with blue light. There were significant interactions between color and intensity of lights in all behaviours, except for the time spent in feeding and sitting. An increase in intensity of the red light increased the proportion of time spent in standing, walking, drinking, wing stretching, and being aggressive, whereas an increase in blue light intensity only slightly increased stretching and aggression. A decrease in dozing, sleeping, and pecking occurred with increased intensity in the red light, but not with the blue light. Feeding times were longer and sitting time was less in red than blue light. Feeding time also increased at high intensity in both colors. Broilers showed a fairly resilient time-budget across light sources and intensities, whereas age and time-of-day affected most behaviours recorded. The birds spent 61% of their time resting in the litter at 6 weeks of age but resting was not significantly affected by light source or illuminance. However, the broilers showed less feather-pecking behaviour in warm-white rather than biolux light and more foraging behaviour in dim rather than bright light intensities (Kristensen *et al.*, 2007)<sup>[21]</sup>. Senaratna *et al.*, 2012<sup>[22]</sup> observed that certain behaviours changed with the Light colour, age, session of the day and their interaction effect where standing and bird interaction significantly decreased with the age. Red and red-yellow mixed light significantly increased walking behaviour whereas birds spent more time on feeding under the green light treatment than with other treatments whereas, walking behaviour was significantly decreased and sitting and standing behaviour was increased under the blue light (Sultana *et al.*, 2013)<sup>[23]</sup>. Broiler chicken showed 70% of their behaviour as resting in all Light emitting diodes light treatment groups (white, red, green and blue) used whereas time spent on standing was higher in green light (13.43 $\pm$ 2.30%), followed by white (10.46 $\pm$ 2.21%), red (9.34 $\pm$ 1.92%) and blue (6.78 $\pm$ 1.92%), and pecking activity was higher in blue followed by white, green and red (Kim *et al.*, 2014)<sup>[24]</sup>. The birds showed a transient feeding preference for low intensity and high intensity at young and old ages respectively, the daily overall results showed higher preferences for non lighting area in both groups and the preference-based lighting regimes indicated that the birds need less lighting time during the daytime than the night time

(Pan *et al.*, 2014) <sup>[25]</sup>. Birds reared under blue and green light were more calm and relaxed while as those reared under red or yellow light exhibited aggressiveness (khaliq. *et al.*, 2018) <sup>[26]</sup>

### Effect of coloured light on Economics of broiler production

Hajra *et al.*, 2009 <sup>[27]</sup> calculated economics based on income and expenditure, profit/loss and they found that using fluorescent light economic return (Rs.7.5/bird) increased as compared to incandescent light (Rs. 2.8/bird) while Ghuffar *et al.*, 2009 <sup>[28]</sup> found metal halide light as the best source of light on the basis of profit and maximum profit (30.14 Rs/bird) was found under metal halide light and next to it was fluorescent light group with profit of Rs.22.895 followed by incandescent light, No light and high pressure sodium light groups having profit Rs. 17.02, Rs. 12.96 and Rs. 10.51 respectively. Economic returns from the birds reared under blue light were highest as compared to green and control group while as loss was encountered in the birds reared under red light. Highest profit of Rs 16.16/ bird was obtained in blue group. Profit/bird to the tune of Rs 7.72 and 2.62 were realized in green and the control group also but a loss of Rs 6.10 was incurred in case of the birds reared under red light (Khaliq *et al.*, 2017) <sup>[29]</sup>

### Conflict of interest

Authors declared that there is no conflict of interest.

### Conclusion

From this review, it can be concluded that Broiler birds under coloured light bulb treatment groups were better in terms of growth performance by increasing the overall body weight gain, reducing the FCR, lowering the stress level and by improving the level of immunoglobulin's thereby boosting immunity. Economically birds under coloured light bulb treatment groups were having better benefit cost ratio.

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